# The GEO-SEQ Project

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## RESEARCH OBJECTIVES

The GEO-SEQ Project is a public-private applied R&D partnership, founded with the goal of developing the technology and information needed to enable safe and cost-effective geologic sequestration of $CO_2$ by the year 2015. The goals of the project are to:

- Lower the cost of geologic sequestration by (1) developing innovative optimization methods for sequestration technologies, with collateral economic benefits such as enhanced oil recovery (EOR), enhanced gas recovery (EGR), and enhanced coalbed-methane production, and (2) understanding and optimizing trade-offs between $CO_2$ separation and capture costs, compression and transportation costs, and geologic-sequestration alternatives.
- Lower the risk of geologic sequestration by (1) providing the information needed to select sites for safe and effective sequestration, (2) increasing confidence in the effectiveness and safety of sequestration by identifying and demonstrating cost-effective monitoring technologies, and (3) improving performance-assessment methods to predict and verify that long-term sequestration practices are safe, effective, and do not introduce any unintended environmental impact.
- Decrease the time to implementation by (1) pursuing early opportunities for pilot tests with our private sector partners and (2) gaining public acceptance.

## APPROACH

The GEO-SEQ Project consists of four coordinated and interrelated tasks carried out by a multidisciplinary team from eight research organizations: Berkeley Lab, Lawrence Livermore National Laboratory, Oak Ridge National Laboratory, Stanford University, Texas Bureau of Economic Geology, Alberta Research Council, and NITG-TNN, The Netherlands.

The research is conducted with the participation, advice, and cooperation of DOE's National Energy Technology Laboratory and five industry partners: Chevron, Texaco, Pan Canadian Resources, British Petroleum, and Statoil. In addition, through ongoing collaborations and our advisory committee, the team extends to include other universities and a number of public and private research organizations.

## ACCOMPLISHMENTS

Highlights of the research conducted to date include:

- Screening criteria for selection of oil reservoirs that could be candidates for co-optimizing $CO_2$-EOR and $CO_2$ sequestration were developed.
- Engineering approaches have been developed to increase $CO_2$ storage, while at the same time enhancing oil recovery.
- Numerical simulations have been carried out to show changes in mineralogy and porosity in a brine-saturated sandstone formation resulting from injection of $CO_2$ waste streams that are impure (i.e., that contain $SO_2$, $NO_2$, and $H_2S$).
- Numerical reservoir simulations have shown that it is technically feasible to enhance recovery of gas while at the same time sequestering $CO_2$; the market conditions needed to make the process economical have also been evaluated.
- Software tools have been developed to evaluate the sensitivity of candidate geophysical monitoring methods.
- Effects of hydrocarbons and clay on isotopic compositions need to be taken into account in using isotopic tracers for monitoring reservoir processes.
- State-of-the-art coalbed-methane numerical simulators have been compared, using a set of benchmark problems incorporating increasing levels of complexity.
- An international comparison study of reservoir simulators for oil, gas, and brine formations has been completed.
- Combined crosswell seismic and electromagnetic (EM) surveys were used to quantitatively map gas saturation in a $CO_2$ EOR pilot in Lost Hills, California.
- The concept of a capacity factor, which could be used to quantitatively compare the sequestration capacity of specific sites, has been developed.
- A pilot brine formation $CO_2$ injection experiment is being conducted in collaboration with the Texas Bureau of Economic Geology.

## SIGNIFICANCE OF FINDINGS

The climate of the earth is affected by changes in radiative forcing caused by several sources, including greenhouse gases ($CO_2$, $CH_4$, $N_2O$). Energy production and the burning of fossil fuels are substantially increasing the atmospheric concentrations of $CO_2$. One of several proposed strategies to reduce atmospheric emissions is to capture $CO_2$ from fossil-fuel final power plants and sequester it deep underground. Results from the GEO-SEQ Project are providing methods and information to enable safe and cost-effective geologic sequestration.

## RELATED PUBLICATIONS

Publications of the GEO-SEQ Project can be found at http://esd.lbl.gov/GEOSEQ/.

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